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Catalogue of the PYTHONOMORPHA *found in the Cretaceous Strata of Kansas.*

BY E. D. COPE.

(*Read before the American Philosophical Society, December 17th,* 1871.)

The following brief review is prepared in consequence of the acquisition by the author of a considerable accession of material from the chalk of Western Kansas. Attention is confined to one order of Reptiles at present, owing to its predominant importance in the vertebrate fauna of that time and place, as is indicated by the great profusion of individual remains and specific forms. Although occurring in America wherever the Cretaceous formation appears, they are so far, more numerously represented in Kansas than elsewhere. Though not rare in New Jersey, crocodiles and tortoises outnumber them; but in Kansas, all other orders are subordinate to the *Pythonomorpha*. As is now well known since 1868* the seas of the American continent were the home of this order, while they were comparatively rare in those of Europe. In the latter country we have four species only determined by palaeontologists, viz :

Mosasaurus	2
Liodon	1
? Saurospondylus	1

In North America the species have been exactly determined from three regions, as follows :

Green Sand of New Jersey.

Mosasaurus	6
Baptosaurus	2
Clidastes	2
Liodon	4
(?)Diplotomodon	1
	15

Rotten Limestone, Alabama.

Mosasaurus	1
Holcodus	1
Liodon	3
Clidastes	2
	7

Chalk of Kansas.

Clidastes	3
Edestosaurus	4
Holcodus	4
Liodon	6
	17

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* See Transactions Amer. Philo. Soc., Vol. XIV.

(*To be continued in No.* 88.)

We have additional species from

Carolina (Mosasaurus)	1
Mississippi (Platecarpus)	1
Nebraska (Mosasaurus)	1

making with the others from

New Jersey	15
Alabama	7
Kansas	17
A total of	42

Of these I am not acquainted with any which extends its range into any two of the areas above named, while some of the districts possess peculiar genera. It is nevertheless premature to draw any conclusions as to geographical range, as most of the species are known from but few specimens as yet.

Two genera have recently been discovered in Europe, which have been thought to be allied, or belong, to this order. One of these, *Acrodontosaurus* Hulke, rests on the anterior portion of a maxillary bone with part of premaxillary and teeth. These portions are indecisive as to its affinities. It is from the English Chalk. The second form is the *Danubiosaurus* of Bunzel, which its describer refers to the neighborhood of *Mosasaurus*. It is quite plain after an inspection of his description and figures, that it has no affinity to that genus or to the order *Pythonomorpha*. It is from Neue Welt, from the Cretaceous, near Vienna.

The present investigations have added some points of importance to the history of the structure of the order.

First, as to the pterygoid bones. It appears that these elements are thin plates, having a free laminar termination, and are entirely toothless. They articulate with the palatines by a process which fits their posterior emargination. In *Edestosaurus tortor*, they are about half the length of the palatines. They present no indications of ectopterygoid. The bones named by authors pterygoids, in imitation of Cuvier, are elongate palatines, and the external process extending to the maxillaries, is that seen in Varani, serpents, etc., and is at no time distinct from the palatines.

It has also shown that the supposition of Goldfuss and myself, that the palatines of *Mosasaurus* were in contact on the median line, is an error, and that they are more or less vertical plates, as in *Liodon*. The distinction between these genera, then, rests on the coössification of the chevron bones in the former, and their permanent independence in the latter; perhaps the difference in the form of the teeth may also count for something.

Second, as to the parieto-squamosal arch, which is distinctly developed in *Holcodus ictericus* and *Liodon curtirostris* in its parietal part and *H. coryphæus* in the squamosal part. It was quite strong in the species named.

Third, as to the pelvis. This part, which has been observed by Marsh in *Edestosaurus dispar*, is usually perfect in *Liodon dyspelor*. The pubes are the only elements united below, forming a weak support to the abdomen. The ilia are slender, not united with vertebral processes above, or without indications of such contact. The ischia are the most slender and directed backwards.

Fourthly, in the hind limb. The femur of *L. crassartus* has been described by the writer, and Professor Marsh asserts its existence in *Liodon*, *Clidastes* and *Edestosaurus*. The present collection exhibits both femur, tibia and fibula of *L. dyspelor*, and these elements are now first described. The first mentioned is not larger, sometimes smaller than the humerus, and has a prominent trochanter, nearly connected with the head. The shaft is not curved, and the distal end is expanded. The tibia is a narrow bone expanded at both ends, the fibula is like that of *Plesiosaurus*, but wider, or partly discoid. It has been known to naturalists but not determined. Thus I figured it for *Liodon laevis*,* and Leidy figured it for an upper Missouri species.†

CLIDASTES, Cope.

Proc. Acad. Nat. Sci., Phila. 1868, p. 233. Trans. Amer. Philos. Soc. 1870, 211.

Vertebræ with the zygosphen articulation. [Palatine bones flat and alate, the teeth not exposed at their bases unequally. This point has not been observed in the type species, *C. iguanavus*.]

CLIDASTES CINERIARUM, Cope.

Proc. Amer. Philos. Soc., 1870, 583.

Several individuals from different points near the Smoky Hill River, Kansas.

The largest species.

CLIDASTES VYMANII, Marsh.

Amer. Jour. Sci. Arts, June, 1871.

From two individuals from the Smoky Hill River and its North Fork.

A small species.

CLIDASTES PUMILUS, Marsh, l. c.

From one individual from the Smoky Hill River.

The smallest known Mosasauroid.

EDESTOSAURUS, Marsh.

Amer. Jour. Sci. Arts, 1871, June.

Vertebræ with the zygosphen articulation; palatine bones narrow, partly vertical, the bases of the pterygoid teeth exposed on one side, or pleurodont. (It is uncertain whether the type of *Clidastes* presents this structure or not.)

EDESTOSAURUS TORTOR, Cope, sp. nov.

Vertebræ of the cervical and anterior dorsal regions with round articular faces, not emarginate for the spinal cord. The bodies are elongate and somewhat contracted, and marked everywhere with finer and coarser striæ. Hypapophyses prolonged on the cervicals, the free one of the atlas with a prolonged keel-like process.

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* Trans. Amer. Philos. Soc. 1869, 205. † (Cretaceous Reptiles,) U. S. Tab. viii. fig. 10.

Quadrate bone with long external angle and rather thick anterior ala with broad rugose margin. A prominent obtuse ridge is continued from the external angle to the inferior articular extremity, the distal portion being more acute. A rugose process projects at the point where the posterior hook approaches the body, and is continued as an elevated narrow ridge, parallel to the previously mentioned, to the distal articular surface. A button-like knob appears on the posterior margin of the hook opposite the meatal part. A strong ridge extends on the inner face of the bone from opposite the end of the hook to the base of the great ala. The distal articular surface presents two planes; the narrower at the end of the posterior pair of ridges above described; the larger considerably less distal, like a broad step.

The *maxillary bone* descends regularly in front, uniting with the premaxillary by a minute suture. Its posterior extremity is slender and acute.

The *premaxillary* is short conic, not particularly prominent. The *palatine bone* has a slight expansion on the inner side; on the outer the margin is very narrow.

The *teeth* number seventeen on the maxillary bone. They are compressed, least so anteriorly, and with a cutting edge from base to crown as far as the fifth from the front, in those anterior to that point the posterior edge is discontinued. There are sixteen pterygoid teeth which are smooth and without anterior cutting edge. The *frontal bone* has a low carina along the median line of its anterior portion.

		M.
Length of axis with odontoid process		.078
Diameter of ball of a cervical	vertical	.026
	transverse	.026
Expanse of diapophyses do.		.084
Length of centrum do.		.052
Length of maxillary bone		.363
" ramus mandibuli behind dentary		.31
Length of premaxillary		.04
Total of cranium (=2.33 feet)		.713
Length of pterygoid and palatine		.315
Length of centrum posterior dorsal vertebra		.066
Diameter of ball	vertical	.033
	transverse	.038

The bones of this species are all light and slender. The elongation of the vertebræ indicate that if their number was of the usual amount, the animal was of more than usually slender proportions. The position in which it was found was a partial coil, the head occupying the inside of a turn of the dorsal vertebræ. As compared with *E. dispar* and *E. velox* of Marsh, the present differs in the lack of depression of the centra of the vertebræ, especially the anterior, and in various details of structure of the quadrate bones, as well as the larger number of teeth.

Discovered in Fossil Spring cañon in the grey limestone by Martin Hartwell and Sergeant Wm. Gardner. But one specimen was found, which includes the greater part of the cranium, with the vertebræ as far as the lumbar region.

EDESTOSAURUS STENOPS, Cope, sp. nov.

Indicated by a large part of the skeleton of one individual, and fragments of two others. The first includes a large part of the cranium, with both quadrates, and fifty vertebræ, including the axis. The characters are similar to those of the preceding species, but all the bones are more massive, though of the same dimensions.

The teeth are strongly compressed, with cutting edge fore and aft, and with the surfaces distinctly faceted; there are seventeen on the mandible. The palatine bones are stouter than in *E. tortor*, but the teeth are not larger, and are probably as numerous, as they are similarly spaced.

The *vertebræ* exhibit round articular surfaces, those of the dorsal region being rather stouter than the cervical, though the difference does not appear to be so marked as in the preceding species. The anterior caudals possess wide diapophyses. The articular faces are a vertical oval, a little contracted above, sometimes by a straight outline. They preserve a peculiarly elongate form.

The *quadrates*, like those of the last species, have a very prominent external angle. They present various differences which may be regarded as individual; for example, the edge of the great ala is not expanded outwards, but only inwards; the distal articular extremity is wider, the posteriorly decurved hook is more contracted, forming a deeper external concavity behind the external angle. Characters of more importance are the lack of the two ridges which bound the posterior face of the distal end of the bone, that face being thus convex instead of concave, and the process below the meatus is isolated and not continued into a ridge, except internally, when it gives rise to the heavy ridge which extends to the base of the great ala. The button on the posterior aspect of the hook is wanting, its place being taken by a recurvature of the smooth articular face along the margin.

		M.
Length of axis (above)		0.06
Diameter ball	vertical	.027
	horizontal	.027
Length of a posterior dorsal		.069
Diameter ball	vertical	.033
	transverse	.038
Length caudal with flat diapophysis		.033
Depth cup, do.		.031
Width cup, do.		.03
Length mandible (28 inches)		.720
Depth at coronoid process		.150
" " proximal end of dentary		.074
" " distal " "		.02

A fine specimen of this species was found by Martin V. Hartwell near Fossil Spring. Portions of a second were found by Lieut. Jas. H. Whitten on a bluff on Butte Creek.

Both the above species are the most elongate in proportion to their diameter of the order. They are larger in their dimensions than those next enumerated.

EDESTOSAURUS DISPAR, Marsh.

Amer. Jour. Sci. Arts, June, 1871. Smoky Hill River.

EDESTOSAURUS VELOX, Marsh, l. c.

Near the North Fork of the Smoky River.

HOLCODUS, Gibbes, Cope emend.

Vertebræ without the zygosphen articulation. Palatine bones flat, alate, its teeth not unequally exposed at the bases, or not pleurodont.

This genus bears the same relation as regards the palatine bones and teeth, to the genus *Liodon* that *Clidastes* does to *Edestosaurus*, as above defined. The structure of the caudal vertebræ I unfortunately cannot ascertain, and therefore do not know whether they are as in *Clidastes* or *Liodon*. It differs from *Mosasaurus* as it does from *Liodon*, i. e. in the horizontal laminiform palatines.

The name which I use for this genus was originally applied by Dr. Gibbes* of Charleston to a species represented by teeth from the cretaceous of Alabama, but of which no other portions were known. The teeth of the Kansas species now referred to this genus, are very similar in character to those described by Gibbes, so much so as to lead me to believe that when other portions of the *H. acutidens* of that author are known, they will be found to display the more important features here regarded as truly distinctive of the genus. Its place is evidently between *Clidastes* and *Liodon*, the pterygoid bones being those of the former, and the vertical articulations being identical with that characteristic of *Liodon*. In all of the species, traces of the zygosphen appear, but in the H. *coryphaeus*, Cope, the rudiment amounts to a short process directed forwards at the base of each anterior zygapophysis.

The species known as yet are of medium size in the order.

HOLCODUS CORYPHAEUS, Cope, sp. nov.

Characters. Cervical and dorsal vertebræ with the articular surfaces depressed transverse, slightly excavated above for the neural canal. The diapophyses not continued inferiorly to the rim of the cup, on the cervical vertebræ, and not receiving from it a cap of articular cartilage. Occipital crest much elevated, quadrate bone small, the meatal pit depressed between bounding ridges above and below. Rudimental zygosphen not uniting into a keel above. Teeth slender less curved than *H. icterícus*.

Description. This species is chiefly based on one specimen, which includes the greater part of the cranium and seventeen vertebræ, with ribs, Isolated portions of other individuals were also found in the same region of country.

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* The *Mosasaurus* and allies: Smithsonian Contr. to Knowledge, 1851, 9 Plate.

The disproportion between the diameters of the cervical and dorsal vertebræ is more marked here than the species of *Edestosaurus*. The centra are less elongate, though with larger diameter. The cranium is relatively much smaller, the teeth absolutely smaller, though the quadrate bones are of equal size. The general character of the species is stouter, but less strongly armed, and less elegantly built.

The hypapophysis of the *atlas* has a short small keel below. The neural spine of the *axis* is elongate, but less so than in the two *Edestosauri*, truncate behind, with a median groove into which the anterior keel of the neural spine of the third cervical vertebra is applied. The diapophysis of this vertebræ has a short vertical articulating surface, and is continued into a longitudinal keel, which disappears before reaching the edge of the cup. The same process of the axis has a longitudinal parallelogrammic articular surface.

The *supraoccipital* is very thick and is roof-shaped, the keel rising nearly perpendicularly from the foramen magnum.

The *suspensoria* are directed both upwards and backwards, at about an angle of 45° in each direction, and support on their extremities the squamosal bones. These are prolonged, forming part of their appropriate arch. The occipital condyle is transversely oval. The *sphenoid* bone embraces as usual the basi-occipital protuberances ; it is not carinate on the median line below. It sends out on each side near the anterior extremity a sub-horizontal laminar process.

The *quadrate* bone is much like that of *H. ictericus*, but is relatively smaller. While the teeth in that species are smaller, the quadrate is larger, hence the difference in the species is in this point quite striking. The external angle is prominent but very obtuse, and is the summit of a very thick obtuse ridge which extends to near the distal articular surface. The posterior hook is much prolonged downwards and has no button-like process or extension of the articular surface on its posterior face. This face presents a strong rib along the meatus and disappearing above the pit, throws the latter into a depression. This is increased by the swelling of the external angular rib. A prominent knob very rugose at the extremity rises beneath the end of the hook, and bounds a concavity between it and the external rib.

The latter closes the concavity by curving round towards the knob above mentioned. A keel rises exterior to the rib, and below it, and continues into the external angle of the articular extremity. Another very prominent keel extends from the knob beneath the hook to the base of the great ala. The articular extremity is transverse, and in one plane.

The *maxillary bone*, is marked with shallow longitudinal grooves. It supports eleven teeth and has a rather steep premaxillary suture descending in front. The nareal expansion in front occurs opposite the fourth tooth.

The *teeth* are rather long slender and incurved and recurved. There is a distinct cutting edge anteriorly and on a greater or less part of the length of the posterior face. The crowns are four or five faceted on the outer face ; the inner face is more numerously faceted, and striate-grooved. The section at the base is sub-circular ; higher, the outer face is flatter, the inner more convex. The apex is acute and the cutting edges strong.

The *frontal* is narrow, and differs from the other Holcodi here described in having the olfactory groove closed by contraction behind. Both *palatines* are preserved. They support twelve cylindric conic teeth which have recurved apices and striate enamel. The section is a flat transverse oval, where the external transverse process is given off. The shaft of the bone is much expanded inwardly with a thickened margin ; exteriorly the margin is thin, and is nearly followed by the series of teeth, whose bases are exposed externally, and are therefore pleurodont. The emargination for the pteryoid is very deep.

	M.
Length of axis with odontoid	0.074
" third cervical	.048
Diameter ball, do. { vertical	.021
transverse	.033
Elevation of spine of do. from centrum	.046
Length posterior dorsal	.068
Diameter centrum { vertical	.033
transverse	.048
Length basioccipital and basisphenoid	.084
Elevation occipital crest above floor of foramen magnum	.03
Length suspensorium from foramen ovale	.09
Length os quadratum	.073
Width distal extremity	.036
Length os maxillare	.21
Depth do. at third tooth	.036
Length fourth tooth	.032
" of crown of do.	.021
Length of palatine bone	.155

This fossil was found by the writer projecting from the side of a bluff in a branch of the Fossil Spring Cañon near the mouth of Fox Cañon. The bluff was from 80 to 100 feet in height, and the *Holcodus* was taken from a position forty feet below the summit, from the yellow chalk.

HOLCODUS TECTULUS, Cope, sp. nov.

Established on a number of cervical and dorsal vertebræ of smaller size than those characteristic of the other species of the genus. The centra have not suffered from distortion under pressure. The articular surfaces are depressed transverse elliptic in outline, with a slight superior excavation for the neural canal. A well marked constriction surrounds the ball. There is a rudimental zygosphen in the form of an acute ridge rising from the inner basis of the zygapophysis and uniting with its fellow of the other side forming a production of the roof of the neural canal. The combined keels become continuous with the anterior acute edge of the neural spine. Thus the form is quite different from that seen in the last described species, and constitutes a lower grade of rudiment. The fact that this zygosphenal roof is separated on each side from the zygapophyses by an acute groove, gives the former a distinctness more apparent than real.

The fixed hypapophyses are short and broad. The centra are not elongate. Those of the anterior dorsals present an obtuse keel below.

	M.
Length of a median cervical	0.043
Diameter of ball of do. { vertical	.02
{ transverse	.033
Length of anterior dorsal	.042
Width of cup	.032

Found by the author on a low bluff or "break" on Butte Creek, fourteen miles south of Fort Wallace.

HOLCODUS ICTERICUS, Cope.

Liodon icterícus, Cope, Proceed. Amer. Phil. Soc. 1870, p. 577. Hayden's Geol. Survey of Wyoming and adj. Terr. 1871.

In adition to the two individuals of this species procured by Professor B. F. Mudge in one of his geological surveys, the writer obtained a considerable part of a third from a low bluff on Fox Cañon, south of Fort Wallace. This includes seventeen lumbar, dorsal and cervical vertebræ including axis, with ribs, and a large part of the cranium with both quadrates, occipital and periotic regions, etc. Its characters may be briefly pointed out as follows:

Articular surfaces of dorsal and cervical vertebræ transverse oval, excavated above for neural canal; diapophyses not extending below to the edge of the cup, hence not receiving an area of articular cartilage continuous with the rim. Occipital crest low, oblique. Quadrate bone larger, the meatus depressed between ridges. A button of articular surface on posterior face of hook. Scarcely any rudiment of zygosphen. Teeth small, much incurved, faceted and striate ridged.

Some characters additional to those already derived from the first known examples may be added. *The mandible* supports only twelve teeth. *The palatine* bone is shorter anterior to the external process, and longer behind it than in *H. coryphæus*. In our specimen, the posterior extremity is broken off, yet shows no indication of the emargination for the pterygoid bone an inch behind the position of its anterior extremity in *H. coryphæus*. There are ten teeth on the part preserved, four in front of transverse process (six in *H. coryphæus*), and six (probably seven) behind (six in *H. coryphæus*). The plate is more expanded than in the last named species, especially the thickened inner margin, which only approaches the basis of the last tooth; (reaches the tooth line at the fifth in *H. coryphæus.*)

The *occipital* crest is low and directed obliquely forwards from the foramen magnum. The suspensoria are stout, and directed at an angle of 45° in both the superior ard posterior directions. The *basisphenoid* is strongly keeled below. The *quadratum* is like that of *H. coryphæus* in its massive external angle and ridge, but differs in the shorter hook and the non-interruption of the groove between the external angular ridge and the knob below the meatus. The cervical and dorsal *vertebræ* display the same disproportion in size, observed in *H. coryphæus.*

	M.
Length os quadratum	0.081
Width articular extremity of do.	.038
Length dentary bone	.28
" tooth of do. third from behind	.022
" " crown only	.016
" suspensorium from foramen ovale	.108
Total length cranium (23 in.)	.58

Holcodus mudgei, Cope.

Liodon mudgei, Cope, Proc. Am. Philos. Soc., 1870, 581. Hayden's Survey Wyoming, etc., 1871, p. 581.

The specimen of this species obtained by Professor Mudge on the Smoky Hill River, is the only one known to the writer. The characters distinguishing it are the following:

Vertebræ without rudimental zygosphen. Quadrate bone with plane surfaces from the proximal articular surface and the external obtuse angled ridge to the meatal pit; the latter therefore not sunk in a depression as the other species.

The frontal bone is like that of *H. ictericus,* furnished with an open olfactory groove on the inferior face; it is wider over the orbits.

A re-examination of the vertebræ of the type specimen, which I described as having compressed centra, renders it probable that they have been so modified by pressure as to render their normal shape a matter of uncertainty.

LIODON, Owen, Cope, emend.

Trans. Am. Philos. Soc., 1870, p. 200.

Vertebræ withont zygosphen and zygantrum. Palatine bones separated from each other, narrowed, the teeth more or less pleurodont. Chevron bones articulated freely with the caudal vertebræ.

This genus embraces several species from the Kansas Chalk, which range in size from the most usual in the last genus, to the largest known in the order.

Liodon curtirostris, Cope, sp. nov.

Characters. Cervical and dorsal vertebræ with transversely oval articular faces, which are little depressed, and though not continued to the neural arch, are scarcely excavated above for the neural canal. The diapophysis with stout inferior horizontal branch, which is capped by an extension of the articular catilage from the rim of the cup. Occipital crest elevated, sub-vertical. Quadrate broad below; pit sunk between bounding ridges.

Description. There is a great disproportion in the sizes of the cervical and posterior dorsal vertebræ; the centra of the latter are rather more depressed than those of the former. They are similar in proportion to those of the *Holcodi* and shorter than those of the *Edestosauri.* The short axes of the articular faces are sub-vertical. The rudiment of zygosphen is seen in the slight anterior prolongation of the roof of the neural canal. The keel of the hypapophysis of the atlas is short and obtuse.

The greater part of the *cranium* is preserved. The supra-occipital keel is vertical and furnished at the summit with a plicate knob for the insertion of a *ligamentum nuchæ.* The thickness of the walls of the bone is not equal to that in *H. coryphæus* and the suture is a double squamosal *i. e.* with groove along the middle of the edge. The basisphenoid is but slightly keeled below, and is distally expanded into a horizontal plate on each side. The parietals are, as usual, confluent, and send off two light arches postero-laterally for union with the squamosal bone. Between their origins are two sub parallel ridges which disappear, the transverse section of the narrow part of the parietals being. rounded. The lateral ridges within the temporal fossæ are obsolete, while the convergent angles which bound the parietal table posteriorly are strongly marked: This table is nearly plane and the *foramen parietale* is large. The *frontal* is narrowed in front, and has an elevated keel along its anterior half. The olfactory groove is not much contracted behind, but is closed by the apex of the rugose area in front of the *foramen parietale.*

The palatine bone is narrow and the external margin is very slight, the bases of the teeth being exposed in that direction. The inner margin is much thickened downwards, but not so as to be a vertical plate. The hinder part of the bone is flat and horizontal, with a long maxillary process. The pterygoid notch falls opposite the second tooth from behind. The whole number of teeth is eleven.

The *jaws* are represented by the greater part of all of the tooth-bearing portions. The maxillary bone is shallowly sulcate on the exterior face. Its proportions are quite similar to those of the *H. coryphæus*, but the teeth it supports are larger and fewer. There are none missing from the extremities of the specimen, the whole number being ten; in *H. corphyæus* there are eleven. The crowns are incurved, faceted externally, and striate-grooved internally; there are cutting edges on front and rear, both strongest near the apex; the anterior continued to the base, the latter wanting on the basal third on median maxillaries. The anterior nareal expanse marks the fourth tooth from the *premaxillary* suture. The *premaxillary* bone is remarkable for its shortness and flatness at the extremity, this part being depressed and scarcely projecting at the lower margin in front of the anterior teeth. These as usual number four.

Both *quadrate* bones are preserved nearly entire. They have the same general character as those of *H. ictericus* and *H. coryphæus*, resembling rather the latter in the great length of the posterior hook, which is without posterior marginal button. The proximal external angle is large and obtuse, and is continued into a prominent thick ridge. The latter divides below, the thick extremity turning inwards and ceasing; an acute ridge continuing outwards and joining the exterior acute extremity of the distal articular surface. The submeatal knob is broad and thick, and not prominent, and its extremity turns at an acute angle forwards on the inner face and forms the commencement of the great ala. The articular surface is straight crescentic with an expansion on a tuberosity on the outer face (concave of crescent). The meatal pit is sunk between the ridges surrounding, one of which is on the outer margin of the posterior hook.

The *mandible* is nearly perfect. The dentary bone bears thirteen teeth, and at the extremity is contracted in both directions, and not prolonged beyond the base of the last tooth. The ridge which descends from the cotylus along the inner face of the articular bone, is not nearly so strong as in the *H. mudgei.*

	M.
Length axis with odontoid	0.062.
Elevation neural spine of do. at middle	.046
Length third cervical (body)	.05
Diameter ball vertical	.025
horizontal	.032
Length posterior dorsal	.065
Diameter ball vertical	.038
horizontal	.05
Length basis cranii	.09
" suspensorium	.105
Elevation occipital crest above floor foramen magnum	.045
Length tooth line pterygoid	.115
" maxillary bone	.21
" premaxillary laterally	.035
Width " " at second tooth	.041
Length dentary	.245
" maxillary tooth	.03
" " " crown only	.023
" os quadratum	.077
Width " " distally	.045
Length parietal	.085
" frontal to nares (median)	.11
Width " between orbits	.077
Total length of cranium (18.75 inches)	.473

The specimen above described was found by the writer on the denuded foot of a bluff on the lower part of Fossil Spring Cañon. The posterior part of the cranium with several vertebræ were found exposed, and many other bones, including the cranium were found only covered by the superficial washed material. Other portions were exposed on excavating the blue grey bed of the side of the spur adjoining.

The name has reference to the abbreviation of the head and jaws.

LIODON GLANDIFERUS, Cope, sp. nov.

This species is represented by portions of two individuals from localities twenty-five miles apart. These are unfortunately in each case only a cervical vertebra, but they agree in possessing such peculiarities as distinguish them widely from anything yet known to the writer.

One is an anterior, the other a posterior cervical. The articular surfaces are transversely elliptic, and completely rounded above, that is, neither truncated nor excavated for the neural canal. Their vertical axes are oblique, *i. e.*, make less than a right angle with the long axis of the centrum, and the articular surface of the ball is thus carried forward, on the upper face, to much nearer the base of the neurapophyses than usual, in the anterior vertebra nearly touching them. The ball is likewise more convex than in any other species, having a slight central prominence in the posterior vertebra. There is no annular groove round the ball. In both, the articular surface of the hypapophysis is truncate and bounded by an elevation in front, a peculiarity not observed in any of the species already described. There is no trace of zygosphen in either. In the anterior vertebra the diapophyses are nearly horizontal, the posterior portion slightly thickened and oblique. The anterior portion is thinned out and very rugose above and below, and does not continue its margin into the rim of the cup. In the second vertebra, the diapophyses are very large, vertical and with a horizontal portion rising in a curve to join the middle of the lateral margin of the cup. Neural spine narrowed upwards keeled behind.

		M.
Length centrum anterior vertebra		0.064
Diameter ball	vertical	.03
	transverse	.039
Length of posterior		.064
Diameter ball	vertical	.03
	horizontal	.043
Expanse of anterior zygapophyses		.055

The first vertebra was found by the writer at the foot of a bluff on the lower part of the Butte Creek; the second was procured by Professor B. F. Mudge from a point one mile south-east of Sheridan near the North Fork of the Smoky River.

It is this species that I compared with the *Mosasaurus depressus*, Cope, in a report on the collection made by Professor Mudge (Amer. Philos. Soc., 1871, 168 Proceedings). The size is similar, but the form of the articular surfaces is very different.

LIODON LATISPINUS, Cope.

Proceed. Amer. Philos. Soc. 1871, p. 169.

This is a large species, nearly equaling the *L. mitchellii* in its dimensions.

that is forty or fifty feet in length. The remains representing it consist of seven cervical and dorsal vertebræ, five of them being continuous and enclosed in a clay concretion.

These display the elongate character seen in *L. laevis*, etc., but the articular surfaces are transversely oval, thus resembling the *L. ictericus.* they are less depressed than in *L. perlatus* and *L. dyspelor.* The cup and ball of the penultimate cervical are a little more transverse than those of the fourth dorsal, and none of them are excavated above by the neural canal. The last cervical is strongly keeled on the middle line below, and with a short obtuse hypopophysis marking the beginning of the posterior third of the length; the median line of the first dorsal has an obtuse ridge. There is no keel on the fourth dorsal, but the lower surface is concave in the antero-posterior direction. The diapophyses on the last two cervical and three first dorsal vertebræ have great vertical extent; the articular surface for the rib is not bent at right angles on the first dorsal. Neural arches and spines are well preserved in most of the specimens. There is no trace of zygantrum. The neural spines are flat, and have considerable antero-posterior extent on cervical as well as dorsal vertebræ, and are truncate above. The first dorsal bears a long strong rib.

	M.
Transverse diameter cup penultimate cervical vertebra...	.051
Vertical diameter of same...........................	.041
Length centrum fourth dorsal, without ball..............	.072
Vertical diameter ball...................................	.0455
Transverse do.	.0555
Elevation front margin neural spine penultimate cervical..	.088
Antero-posterior diameter do. do. do. ..	.05

There are smooth bands around the balls, and the surfaces of the centra are striate to these.

The depressed cups of the cervicals and anterior dorsals distinguish this species from the *L. validus*, *L. proriger* and *H. mudgei.* The same elements are much larger and more elongate than in *L. ictericus.*

It differs especially from these species of *Holcodus* and from *Liodon curtirostris* in the elongate form of the anterior dorsals; in the latter, they are much shorter and in three of them at least, the inferior limb of the diapophysis is turned forwards to meet the rim of the cup, while this feature ceases with the last cervical in *L. latispinus.* The articular surfaces have planes at right angles to the axis of the centrum and are not prolonged above as in *L. glandiferus.* The last hypapophysis is very short, with the anterior margin transverse and elevated as in the last named species.

In size, this species is intermediate between such gigantic forms as *L. dyspelor*, and the lesser *L. curtirostris.*

The type specimens were found by Professor B. F. Mudge, one mile south-west of Sheridan near the "Gypsum Buttes."

LIODON CRASSARTUS, Cope, sp. nov.

Liodon large species near L. proriger, Cope, Proc. Am. Philos. Soc., 1871, p. 168.

This saurian, which is similar in size to the last, is represented by a series of dorsal lumbar and caudal vertebræ with some bones of the limbs.

The vertebræ are as much distinguished for their shortness, as those of *L. latispinus* are for their elongation. The articular faces are but little broader than deep, and their axes are slightly oblique. They are very slightly truncate above by the neural canal. The inferior face is somewhat concave in the longitudinal direction. The zygapophyses are stout and there are no distinct rudiments of zygospen.

The dorsal vertebræ best preserved are those in which the diapophyses reach the middle of the sides of the centra, and have no horizontal limb. They are narrow and have not extensive articular extremital surfaces.

The lumbars and anterior caudals have round articular surfaces. One of the latter with strong diapophyses but posterior, is sub-pentagonal in outline of cup. The humerus is a remarkable bone having the outline of that of *Clidastes propython,* Cope, but is very much stouter, the antero-posterior dimensions of the proximal extremity being greatly enlarged. The long diameters of the two extremities are in fact nearly at right angles, instead of in the same plane; and the outline of the proximal is subtriangular, one of the angles being prolonged into a strong deltoid crest on the outer face of the bone, which extends half its length. The inner or posterior distal angle is much produced, while the distal extremity is a flat slightly curved diamond-shaped surface. The fibula is as broad as long and three-quarters of a disc. The phalanges are stout, thick and depressed, thus differing much from those of *Liodon ictericus.* A bone which I cannot assign any other position than that of femur has a peculiar form. It is a stout bone, but more slender than the humerus. The shaft is contracted and subtrilateral in section. The extremities are flattened, expanded in directions transverse to each other, the proximal having, however, a lesser expansion, in the plane of the distal end. The former has, therefore, the form of an equilateral spherical triangle, the apex enclosing a lateral fossa, and representing probably the great trochanter. The distal extremity is a transverse and convex oval.

This bone is either ulna, femur, or tibia, judging by form alone. Its greater length as compared with the fibula, forbids its reference to the last; the trochanter-like process of the head is exceedingly unlike any examples of the second bone I have seen. Its reference to femur is confirmed by its presence with the caudal-vertebræ of a similar species from near the Missouri River, Nebraska, and its resemblance to the femur of *L. dyspelor.*

	M.
Length humerus	0.10
Proximal diameter do	.095
Distal " "	.102

	M.
Length femur	.08
Proximal diameter do	.065
Median " "	.035
Length centrum dorsal vertebra without ball	.061
Transverse diameter cup	.06
Vertical " "	.053
Length of a lumbar (total)	.055
Diameter ball do (transverse)	.06
Length caudal	.041
Depth ball do	.052
Width do do	.052

The form of the humerus is something like that of *Ichthyosaurus*.

Both this element and the femur are remarkable for their small size. They are scarcely half the dimensions of the elements of the anterior limb of *Holcodus ictericus*, and are even less than those of *L. dyspelor* in proportion to the animal's size.

It is unnecessary to compare this species with any but the *Liodon proriger*. Of this species, I unfortunately do not possess any of the limb bones, and must rely for comparison on vertebræ alone. The type specimen lacks the dorsals, hence the caudals alone remain for comparison. This shows that they are three or four times as large as the same proportions of the *L. crassartus*. In a smaller specimen of *L. proriger*, the dorsals are preserved, but so crushed as to be little available for measurements. One point besides the greater size is noticeable, their generally more elongate form, and the distinct superior emargination for the neural canal.

The remains above described were obtained by Professer B. F. Mudge, near Eagle tail, in Colorado, a few miles west of the line separating that Territory from the State of Kansas.

A series of twenty-nine caudal vertebræ with and without diapophyses, from a bluff on Butte Creek belongs perhaps to this species. The proximal specimens at least, cannot be distinguished from those of Professor Mudge's collection. The distal ones cannot readily be distinguished from the terminal ones of *L. proriger*.

LIODON PRORIGER, Cope.

Proc. Acad. Nat. Sci., 1869, 123. Trans. Am. Philos. Soc., 1870, 202.

This is the most abundant of the large species of the Kansas chalk. The writer found a muzzle consisting of premaxillary, and portions of maxillary and dentary bones, in a spur of the lower bluffs of Butte Creek, and numerous fragments of cranium and vertebræ on a denuded tract in the same neighborhood. Both of these belonged to individuals of smaller size than the type, the opportunity of examining which I owe to Professor Agassiz. The more complete Butte Creek specimen belongs to a huge animal; the size is grandly displayed by a complete premaxillary bone with its projecting snout, and large fragments of the maxillary. These furnish characters confirmatory of those already given as above. The vertebræ are remarkable examples of flattening under pressure, without fracture, some of them having a vertical diameter no greater than one's hand. The cervicals are less flattened and give the impression that they were not transversely elliptic. This is consistent with our knowledge of the perfect specimen, where it is as described, furnished with vertically ovate articular surfaces. In this the cup is symmetrical and not distorted, but the ball is a little compressed by pressure,

The most important addition to the knowledge of this species, furnished by the Butte Creek specimen, is the character of the quadrate bone. The external longitudinal angular ridge is very prominent and extends to the distal end. It supports a hook-like prolongation of the proximal articular surface, almost as large a one as in *Clidastes propython* and more narrowed. The ridge is so prominent as to create a wider face or surface, behind the basis of the great ala than exists between the latter and the edge of the articular meatus. This basis is quite convex outward and embraces a relatively smaller space than in other Pythonomorpha. A section of the bone at the meatus is subtrilateral with a notch behind. The distal articular surface is prolonged below the origin of the great ala, and receives the keeled termination of the external ridge.

	M.
Total length quadrate	0.153
Length from superior to inferior origin of great ala	.08
Length external angle from bases of ala	.052

The two usual ridges pass inward and downwards from the meatal knob.

The above quadrates are flattened from within outwardly by pressure.

A portion of the palatine bone, supporting these teeth, displays the characters of the type, viz.: the inner face vertical and deeper than the outer, and forming a strong parapet of bone on the superior or toothless aspect. The outer face a little expanded laterally : the bases of the teeth exposed.

It is proper to add, that the locality ascribed to the type specimen "near Fort Hays, Kansas," which was given me on inquiry, is probably erroneous, Fort Wallace being the point intended.

LIODON DYSPELOR, Cope.

Proced. Amer. Philos, Soc., 1870, 574; 1871, 168, 172.

This large reptile was first described from specimens sent to the Smithsonian Institution from New Mexico. Professor Mudge subsequently obtained it in Kansas, and on my late expedition I had the good fortune to procure a large portion of another, on a sloping bluff on Butte Creek, fourteen miles south of Fort Wallace. This specimen is one of the most instructive which has yet been discovered, including as it does fifty vertebræ from all parts of the column, a large part of the cranium with teeth and both quadrate bones; the scapular arch complete, except lack of coracoid on one side, both humeri, radius and numerous phalanges of fore limb ; the pelvic arch complete with one hind limb complete to tarsus, with phalanges. The premaxillary is wanting, but the adjacent suture of the maxillary remains.

The *fronto-nasal septum* is convex in transverse section. The *maxillary* bone is much attenuated anteriorly, and supports thirteen teeth. The *ramus mandibuli* is high and slender; the angle is quite produced, and the median articulation indicates considerable mobility. The *palatine* bones are narrower than in any of the species previously described. They are deeply notched for union with the pterygoids, and the superior posterior process terminates in an acute cone. In front of the articulation, the bone is a vertical plate slightly concave on the inner side ; the anterior half is subquadrate in section, the outer face subvertical, the inner, regularly rounded. The inferior surface is marked with a groove which passes from the inner side to the outer. The portion on the outer side of this groove, is on the distal third of the bone produced downwards into a prominent keel or ridge. The anterior extremity is an acute point. Each bone bears eleven teeth, all of which have the external faces of their roots exposed. The bones are curved outwardly from the fourth tooth from behind ; opposite the sixth there is longitudinal concavity on the inner face.

The occipital region and suspensoria are not present, but both, *quadrates* were found perfectly preserved excepting the thin ala. They present marked characters, being most nearly allied to those of *L. proriger* and *L. validus*. The proximal articular surface exhibits an obliquity in the transverse direction. It presents a large external angle which instead of being nearly at right angles to the axis of the main portion of the surface, is nearly in the same line. The decurved posterior hook is very short. The distal articular surface has, like that of other *Liodons*, a small transverse extent, and is divided by a concavity into two tuberosities. The outer of these receives at its angle the prominent narrow portion of the external ridge, which extends from the external proximal angle. The prominence of this ridge is greater than in any other species except *L. proriger ;* it is acute throughout its length and has a gentle sigmoid flexure. The basis of the great ala includes a smaller area than usual and is continuous with a prominent narrow ridge which proceeds from inside the metal crest. The metal crest takes the place of the "knob" in such *Mesasauri* as *M. dekayi*, it projects strongly backwards and outwards as an angle of two ridges ; the inferior being acute and curved and terminating above the middle of the distal condyles. The meatal pit is not concealed between ridges, but is external ; its form is peculiar, being a narrow oval, three times as long as wide, directed downwards and forwards. Thus the characters of this element are well marked among those pertaining to the other species.

The *teeth* are not much compressed, and have a cutting angle on the anterior and posterior margins, which separate nearly equal faces.

The *vertebral centra* change in form from the anterior to the posterior regions. The ball of the axis is round, those of the vertebræ early succeeding are moderately depressed. The balls of the dorsals are transverse elliptic with a slight concavity for the neural canal; the plane a little oblique to that of the long axis. The centra are more depressed posteriorly where the balls of the dorsals present rounded lateral *angles*. On the lumbars preceding the caudals, the base of the neural canal becomes more elevated, and the articular faces assume a slightly pentagonal outline. This form continues as far as our specimens of caudals extend. On three lumbars, the centra present two longitudinal angular ridges below, at whose posterior ends the chevron articular surfaces appear on the first caudals. All present an incised marginal groove to the ball. The surface, especially the inferior, is strongly rugose up to this groove, especially on the dorsals.

The *axis* is much shorter than in any other species here noted, where known. The neural spine has a very oblique superior margin and is expanded behind. The diapophyses are narrow, and continued as vertical plates to the inferior face of the centrum at its anterior margin. The diapophyses of the other cervicals have the usual horizontal limb, which is, however, shorter than the vertical. In the anterior dorsals, they are directed more obliquely upwards and are longer. These, and all other dorsals, maintain a connection between the rim of the cup, and the anterior basis of the diapophysis by a smooth area apparently capped by cartilage in life, as exists in *L. curtirostris*. As we pass posteriorly these processes descend, and become narrower, until finally they thin out and lengthen into the ribless diapophysis of the lumbars. Those of the caudals are long and subcylindric. Their extremities are deeply striate grooved. The neural spines of all the vertebræ are longitudinaly striate keeled. The zygapophyses are remarkable for their narrow form and surfaces. The *atlas* is shorter on the outer, and longer on the inner face than in *L. validus*. This is caused by the fact that the posterior articular face is not transverse, but very oblique, and instead of being vertical and narrow, is obliquely longitudinal in its long axis. It is separated from the inner face by a wide rugose groove behind; its lower edge sends a keel downwards. There is no process at the thinned infero-anterior angle.

The *scapular arch* was small especially the scapula, which is absolutely smaller than that of the *Holcodus ictericus*, a very much smaller reptile. The posterior margin is thickened, the anterior thinner, and less elevated. The superior is arched upwards and backwards. The general form is less oblique than in *L. ictericus*. The *coracoid* is twice as large, and is flat and thin. Its inner margin is regularly convex, the posterior concave and thin, the anterior thickened. The foramen is present.

The *humerus* is different in form from that observed in *L. crassartus*, *L. ictericus*, *Clidastes*, *etc.* It is relatively less expanded proximally and especially distally; there is but one deltoid crest, which is proximal and near one extremity of the articular surface, and disappears into the general plane above the middle of the shaft. The general form is flat, partly due to pressure. The distal extremity is but little convex and displays the terminal muscular insertions but little produced. Near the inferior end there is one external expansion for articulation with the ulna.

The *radius* is lost. The ulna, or a bone which is like that regarded as such in several species described by me, has the extremities in different planes which cross each other obliquely. The proximal is triangular and very wide, too wide for the humeri in their present state. It is also too long, leaving but little space for a radius. The distal extremity is as expanded, but much narrower, and presents too articular surfaces, a large and wide, and a narrow, connected by a wide isthmus. The bone was taken out near a humerus, but not in position.

The pelvic arch, as above remarked, was found perfect, and with all the elements in place, with a femur with the head in relation to the acetabulum. The articular extremities are somewhat depressed and do not precisely fit. The *ilium* is a straight flattened bone, dilated moderately at the articular extremity. It is coarsely rugose striate at both extremities. The *ischium* is a longer bone than the ilium, is more slender, and more expanded at the articular extremity, where it is also thickened. The shaft is curved so as to be sub-horizontal in position; it shows no trace of union with its mate. The *pubis* is a broader bone, with the axis transverse to that of the body, and sigmoidally curved, first slightly forward then gently backwards. The common suture is about as wide as the proximal extremity. The posterior margin is somewhat thickened; the anterior is produced into a process directed forwards, which is the homologue of that seen in the *Testudinata.* It is connected with the distal end by a thin concave margin.

The *femur* is rather more slender than the humerus; the distal extremity is about as much dilated, the head less so. The great trochanter is a thick convex ridge with a truncate discoidal articular extremity, which is nearly separated from the head by a groove. Both extremities are moderately convex. The *fibula* is similar to that of other species in its broad, three-quarters discoidal form. Both articular surfaces are strongly convex and are continued on the inner side on the thinned inner border. The external margin is thickened and deeply concave, and without tuberosity. The *tibia* is a more slender element with sub-cylindric shaft and much expanded extremities. The proximal is oval and is continued as a narrow ridge on the inner side, for contact with the corresponding ridge of the fibula. The distal extremity is an equilateral spherical triangle, of which the inner angle is on a different plane from the remainder.

The *phalanges* are slender with cylindric shafts and expanded extremities, which support oval articular surfaces. Those of the two extremities appear to be similar. The distal ones are extremely small and flat, with expanded extremities.

Of *doubtful bones* may be mentioned two with flat expanded distal extremity and thick proximal, bearing an oval articular surface, with an angulate extremity which terminates in a thin edge. The form is like that of a narrowed radius of *L. ictericus*, but it is much too short for the ulna. As it was found with the scapula, it is probably a portion of the fore limb, and hence may be a metacarpal. A somewhat similar but narrower bone may be metatarsal. A piece which is probably the free *hypopophysis* of the atlas, is a transversely elliptic piece with an oblique smooth articular face at one end. The posterior face rugose, the inferior with a flat truncate process directed downwards and backwards. If correctly identified, its great peculiarity consists in its thinness anteroposteriorly, and the large process.

In comparing this species with the *L. proriger*, its nearest ally, I have already observed the difference in the form of the articular surfaces of the cervical vertebræ, which is in that species vertically oval; the present, transversely so. The comparison is made between posterior cervicals of both, which in *L. dyspelor* are less depressed than the others. As it is possible that the form in the type example of *L. proriger* may be slightly affected by pressure, I compare other points. Thus the palatine bones are more slender anteriorly, and the outer edge descends lowest in a ridge ; in *L. proriger* inner is produced downwards as a longitudinal rib. In this species there are eleven teeth ; in that one, nine. The quadrate bone of *L. proriger* presents a longer external angle, and more prominent external ridge, with smaller space enclosed by the bases of the greater ala. My statement in a published letter to Professor Lesley, that the ends of the mandibles were acute, thus differing from *L. proriger*, is an error, due to my having mistaken the palatines for the dentaries on a cursory examination in the field. The posterior extremity of these bones in *L. proriger* is unknown.

The only species whose dorsal vertebræ are known to resemble in the stoutness of their form those of *L. dyspelor*, is *L. crassartus ;* the manifold differences of the latter will be at once discovered on reading the description already given.

Measurements.

		M.
Atlas length inner articular face		0.065
" " posterior " "		.054
" depth " " "		.037
Axis length at middle of side		.075
" depth anteriorly		.081
" elevation neural spine		.075
" width " " (plane)		.045
" diameter ball	vertical	.07
	horizontal	.07
Cervical " "	vertical	.066
	horizontal	.076
" length		.09
Anterior dorsal, diameter ball	vertical	.065
	horizontal	.087

Measurements.	M.
Anterior dorsal, length below (with ball)	.10
" " " diapophysis	.047
" " depth "	.04
Posterior " length centrum	.097
" " diameter ball { vertical	.076
horizontal	.105
" " height neural spine (of another)	.12
Lumbar length centrum	.09
" diameter ball { vertical	.073
horizontal	.09
" length diapophysis	.096
Caudal (anterior) length centrum	.073
" " depth ball { horizontal	.085
vertical	.075
" " length diapophysis	.12
" (posterior) " centrum	.067
" " " diapophysis	.10
Caudal (posterior) height neural spine	.087
" " diameter ball { vertical	.08
horizontal	.084
Maxillary bone, length	.65
" length basis of two teeth (largest)	.09
Mandible, depth behind cotylus	.11
" length " "	.11
Width nasal septum	.021
Length palatine on tooth line	.38
Depth " at third tooth from front	.039
Quadrate length	.15
" " external angle	.029
" width face from meatus to external ridge	.029
" " area of basis of ala	.04
" " at condyles	.07
Scapula, height (axial)	.12
" width	.183
Coracoid, "	.187
" length	.20
" thickness at cotylus	.027
Humerus, length	.189
" proximal width	.12
" distal "	.127
Ulna, length	.179
" width { proximal	.115
distal	.116
" thickness proximally	.06
Ilium, length	.245
" width { proximal	.039
distal	.178

Ischium, length on curve		.350
" width	proximal	.018
	distal	.087
Pubis, length (straight)		.195
" " to anterior process (axial)		.125
" width	proximal	.085
	distal	.075
Femur, length		.185
" width	proximal	.093
	median	.064
	distal	.130
Fibula, length		.116
" width	proximal	.100
	distal	.118
" proximal thickness		.052
" median width		.08
Tibia, length		.103
" width	proximal	.045
	median	.025
	distal	.052
" thickness	proximal	.042
	distal	.030
Phalange (posterior), length		.08
" terminal "		.015
Estimated length, cranium (five feet)		1.510
" total length		75 feet.

This specimen does not appear to be quite as large as the type, which came from Fort McRae, New Mexico. The diameters of the vertebral centra appear to be larger in proportion to the length of the cranium than in the *Mosasaurus dekayi*, hence probably the body had a greater diameter. In estimating its length, reference is had to the relations in size of the caudal vertebræ of the type of *L. proriger* and to the caudal series of a small *Liodon* found on the bluffs of Butte Creek. The caudal vertebræ are quite similar to those of the former; in the latter, a series of thirty centra exhibit very little diminution in size. On such a basis the length would be about seventy-five feet.

Portions of a second individual of this species or of *L. proriger*, were found on Fox Cañon. They belonged to a larger animal, one equal to the New Mexican first described. Professor Mudge has fragments of still larger specimens.

The principal specimens above described was excavated from a chalk bluff. Fragments of the jaws were seen lying on the slope, and other portions entered the shale. On being followed, a part of the cranium was taken from beneath the roots of a bush, and the vertebræ and limb bones were found further in. The vertebral series extended parallel with the outcrop of the beds, and finally turned into the hill and was followed so far as time would permit. It was abandoned at the anterior caudal vertebræ, for more favorable circumstances, or a more persevering excavator.

The outcrop of the stratum was light yellow. The concealed part of the bed was bluish. Yellow chalk left on the specimens in thin layers became white or nearly so. The yellow and blue strata are definitely related in most localities, the former being the superior, but in others they passed into each other on the same horizon.

Stated Meeting, January 5th, 1872.

Present 14 members.

JOHN C. CRESSON, Vice-President, in the chair.

Letters of acknowledgment were received from Professor Lewis Strohmeyer, Dec. 8th, 1870 (81, 82, Proc. A.P.S.), Boston Public Library, Dec. 19, 1871, R. Saxon Society, Feb. 8, and July 8, 1871 (84, 85, Trans., Vol. XIV., i. ii.), Natural History Society, Bremen, Aug. 29, 1871 (83, 84, 85) Professor Frerichs, Feb. 8, 1871 (83, 84, 85), R. Bavarian Academy, Sept. 18, 1871 (83, 84, 85, XIV., i. ii.), R. Observatory, Munich, Aug. 14, 1871 (83, 84, 85), Imperial Russian P. C. Observatory, March 13, 1871 (62, 73, 74, 78, 81, 82, Trans. Vols. I. to IX., and XIII., iii.), Bordeaux Society of Sciences, Nov. 16, 1871 (82 to 85), R. Academy, Berlin, Aug. 9, 1871 (83, 84, 85, XII. i., XIV. i. ii.), Imperial Observatory, Prag., Aug. 16, 1871 (83, 84, 85, XIV. i. ii.)

Letters of envoy were received from the Chief of U. S. Engineers, Washington, Dec. 21, 1871, and from the Imperial P. C. Observatory, St. Petersburg, Aug. 16, 1871.

Donations for the Library were announced from the publishers of the Flora Batava, and Dr. Schotel, P. C. Observatory, St. Petersburg, Academy and Observatory at Munich, Societies at Bonn and Bordeaux, Geographical Society and School of Mines at Paris, Mr. Stephenson, M. P. Newcastle-on-Tyne, London Nature, R. Astronomical Society, the Natural History Society at Bagota, S. A., the Massachusetts Historical Society, Boston Library, Old and New, Silliman's Journal,